

In the News:

February, 2013 - Two Incidents of Pilots Fainting In Flight

Alaska Airlines said an unspecified illness caused one of its pilots to lose consciousness while flying a Boeing 737-700, leading the copilot to declare an emergency. While the aircraft was at cruising altitude, the pilot – with 28 years of experience – stood up, became dizzy, lost consciousness and fell to the floor. There was a similar fainting episode on January 22, also on an Alaska Airlines aircraft. In that case, the copilot briefly lost consciousness in flight. In both cases, the pilots held current medical certificates. There could be several contributing factors. Evidently, all these Alaska Airlines jets are WiFi-enabled. Potential adverse effects from this exposure can include nausea, vertigo and fainting. Was this a contributing factor?

“My name is Dr Todd Curtis. I am a licensed pilot and Founder of AirSafe.com. In the US Air Force I was a flight test engineer, and while an airline safety engineer at Boeing, I was directly involved in numerous plane crash investigations. I hold a PhD in Aviation Risk Assessment. I have been a frequent on-air aviation expert on CNN, CBS, NBC, ABC, MSNBC, Fox News, CBC, BBC, Discovery Channel, NPR, and numerous other major news media outlets around the world.

The issue of in-flight wi-fi has recently been brought to my attention by Dr. Kerry Crofton and her colleagues. Although the risk of radio frequency radiation from wi-fi and other electrical systems hasn't been looked at as a health and safety risk by the aviation community, the fact that some quarters of the medical and scientific communities have shown that this may be a risk is a concern to me.

In reviewing this material sent to me by Dr. Crofton, it seems there is enough evidence to warrant further investigation.

I am not aware of any tests on in-flight wi-fi systems, or if there is a requirement, with respect to potential health effects on flight crews. However, it appears this new technology has been tested with respect to its effect on the electrical, communications, and navigation systems.

It would make sense for the appropriate authorities, including the FAA, to take a serious look at this issue; one part of the FAA that seems best equipped to look at this is the Civil Aerospace Medical Institute (CAMI.)

Reportedly, there have been separate incidents of two pilots fainting while in flight – apparently on aircraft with wi-fi installations. This could be a huge red flag. That sort of event in the air, with individual pilots being incapacitated, isn't consistently reported in the US because there is no clear legal or regulatory requirement to do so.

Because a wi-fi installation could expose all flight crew members to a potentially incapacitating condition, it is a situation that could affect all flightcrew members at the same

time. Anything that could simultaneously incapacitate all flight crew members would be a major concern. If this were to happen, the flight crew, cabin crew, and passengers could very quickly be in 'a world of hurt.'

The concern is not just for the pilots; it is also for the cabin crew. The cabin crew's biggest job is safety - if they are incapacitated that is also a potential problem, especially during any kind of emergency situation.

There no question that being online while in flight is very attractive for passengers, but there is at least one very tragic case where a system that was installed just for passenger entertainment has led to a catastrophic accident.

The 1998 Swissair crash at Peggy's Cove was due to an damage from an in-flight fire that was caused by an electrical problem in the passenger entertainment system. Like the current and proposed airliner wi-fi systems, this system was there only for the passengers' benefit, and provided no improvement to the aircraft's performance. As entertainment and communication technology advances in this digital age, passengers are looking for in-flight wi-fi, and this is an obvious income generating opportunity for the airlines.

I don't fault the airlines for looking for ways to satisfy customers while creating more revenue-generating opportunities.

However, it is the aviation regulatory bodies' responsibility to ensure that any new technology that is introduced into an aircraft does not have a negative effect on the health and safety of the passengers, cabin crews, and flight crews.

As many of the experts in Dr Crofton's document have stated - there is no evidence that this new wi-fi technology has been tested for short and long term health effects on the crew, or that wi-fi related health problems of flight crews, cabin crews, or passengers are being systematically tracked.

It is therefore quite reasonable to ask if radio frequency radiation exposure from onboard wi-fi systems can cause or has caused pilots to faint while flying a commercial airliner.

As you may know, there is no legal requirement for monitoring these kinds of events, But it doesn't mean that the information is impossible to acquire. As I stated in my first book *'Understanding Aviation Safety Data,'* there are several key questions that one should ask when trying to understand a potential, or previously ignored, safety risk. Among those questions are: who would know, who would care, and who would care enough to record the information. If those three basic questions could be answered, one could begin to systematically address the potential risk.

Todd Curtis, PhD

Aviation Health & Safety in the Digital Age
Radio-frequency (RF) Exposure from Mobile Devices and In flight WiFi
– A New Human Factor?

We are an international group of experts in aviation, medicine, science and engineering. We are raising several key questions as there is evidence of adverse effects on human health and performance from exposure to electro-magnetic radiation, especially radio-frequency/microwave radiation from mobile communication technology. The evidence indicates that adverse effects can occur at levels well below existing safety standards. So the position that the “low level” exposures from WiFi and mobile phones are within government standards (based only on thermal levels) does not dismiss the evidence of biological damage that occurs with *non-thermal* exposure.

There is some good evidence for harm; there does not seem to be conclusive evidence for safety, and there are potential adverse outcomes with wireless technology that have not been thoroughly investigated. We urge you to require proper testing on flight crews before implementation.

Adverse effects can include cardiac symptoms, or a sudden neurological event that could compromise brain function, mental stability and cognitive abilities, even in an otherwise healthy individual with no previous medical history. Even without in flight WiFi, pilots’ exposure is increasing from security screening (often with ionizing X-ray technology), the proliferation of WiFi, and the universal use of increasingly powerful mobile phones and WiFi devices.

Our technical experts caution that effects are magnified in the confined metal space of the fuselage. Our medical experts warn of potential cognitive and cardiac impairment, making this a crucial issue in transportation, especially aviation. Sufficient research was not conducted before the global implementation of WiFi-enabled aircraft. Yes, WiFi is everywhere and there are economic benefits and wide consumer appeal, but should this innovation be allowed when there are health and safety concerns? May we ask to review any testing reports investigating the effects on human health and performance? And have the in flight RF levels in WiFi-enabled aircraft been measured?

We request that our experts’ comments be taken into consideration and that your experts consider a risk assessment of what could happen in a worst-case scenario – cognitive impairment and/or cardiac dysfunction of the pilot, for example. And after reviewing our statements, can they rule out these potential health and safety outcomes?

May we ask if you have considered who will be monitoring accumulated exposures, as well as monitoring usage of mobile devices in flight? Is anyone monitoring WiFi-enabled aircraft to track the flight crew and passengers for potentially related occurrences/symptoms in flight? Are your aviation medical experts up to date with this issue, and the emerging medical condition electro-hypersensitivity (EHS), or microwave sickness syndrome, and its symptoms and adverse effects?

Statements From Scientists, Physicians, Flight Surgeons, Pilots

Full statements from some of these experts are included in this document.

Olaf W. Skjenna, MD, D AvMed, Chief Medical Officer Air Canada (1982-1990)

“My specialty is Aerospace Medicine, I am a commercial pilot and flight surgeon, and was adjunct professor at USC in flight medicine. While I have not reviewed all the literature, from what evidence I have seen it does *not* seem prudent to allow this new WiFi technology on board without further investigation.

As an aviation accident and human factors investigator I know how a combination of factors contributes to accidents. And I haven't seen enough evidence to rule out the possibility that the radiation exposure from in flight mobile devices could become a new human factor.

I believe the issue of in flight WiFi merits further study.”

N. Harv Haakonson, MD, FCBOM, Colonel (Retired) Canadian Forces Former military pilot, licensed Commercial Pilot, Flight Surgeon Fellow of the Aerospace Medical Association

“Re: certifying commercial aircraft for use of in flight WiFi.

Although, in my retirement mode, I can no longer consider myself an expert in these matters, I do remain well informed.

There is clearly enough scientific literature available to cause any experienced reader concern about the potential health and flight safety risks if this certification (changing the air regs to allow in flight WiFi) is done without specific study of the potential implications.

I believe that reasonable consideration has been given to flight operational concerns, though I am not sure the answers are clear, but I do not think the potential impact on the health of passengers, and especially flight crews, has been sufficiently studied to warrant certification at this time.”

Neurologist, Professor Salford, MD, Lund University

“The voluntary exposure of the brain to microwaves from WiFi and hand-held mobile phones is the largest human biological experiment ever. There is clear evidence that this radiation causes leakage of the brain's blood-brain barrier with adverse effects on brain function.”

Hans Scheiner, MD, Environmental Medicine Expert

“Equipping aircraft with WiFi is a dangerous experiment. Even quite low levels of radio-frequency radiation - from WiFi and mobile devices - can open the blood-brain barrier and cause a lot of harm, including miniature edemas destroying brain cells which cannot be renewed.

This damage presents an increased risk of neurodegenerative conditions including Parkinson's disease. At the actual levels of 25,000 nW/cm², which are expected to occur on board commercial airplanes equipped with WiFi, 100% of the animals tested had serious brain damage. **Electro-hypersensitivity (EHS) is another issue: People with this condition may faint, feel dizzy, or their vision might be impaired. It's likely these are signs of opening of the blood-brain barrier.** Doctors often tell them their symptoms are psychological. People may also experience nausea, lack of concentration, muscle weakness and skin reactions.”

Professor Wilhelm Mosgoeller, PhD, University of Vienna:

“During our investigations of healthy human subjects (and RF exposure) certain brain waves changed. We noted faster response times during exposure which seem to occur at the expense of the quality of the response. **Wrong responses were given within shorter time periods.**”

Professor Olle Johansson, PhD of the Karolinska Institute

“The radiation emitted by mobile phones, and other wireless communication devices, has been shown to damage DNA – leading to possible mutations and cancer development, and is linked to impairments to immune function and neurological diseases and functions – including cognition and behaviour. If you look in the literature, you have a large number of various effects like chromosome damage, impact on the concentration capacity, and decrease in short term memory.”

Professor Johansson is a researcher summarizing the science and calling for new standards in the 2011 Seletun Statement. <http://www.iemfa.org/index.php/publications/seletun-resolution>

Cardiologist Stephen T. Sinatra, M.D., F.A.C.C.

“As far as we know, no one has tested the accumulated exposures within the aircraft when a good number of passengers, and flight crew, are using their mobile devices. It is unwise to install wireless technology (WiFi) in public transportation, especially aircraft. We know that the heart is sensitive to, and can be adversely affected by, the same frequency used for WiFi (2.4 GHz) at levels a fraction of federal guidelines (less than 1%).

I would like to see tests on pilots for potential cardiac – and cognitive – effects.”

Professor Devra Davis, PhD (Nobel Co-Laureate, Epidemiologist and Founder of Environmental Health Trust)

“If the cell phone were a drug, it would be banned. And there's concern about other wireless devices including iPads. The epidemiological approach that says the only proof of harm that really counts is enough sick or dead people has to change, particularly with the potential health hazards from WiFi exposure, as health problems may take years to develop. Should we wait? I don't think so, and neither does the European Parliament that has urged caution with this technology.”

Neurosurgeon Vini Khurana, MD

“The concern with mobile phone radiation is not just brain tumors, but other health effects including behavioral disturbances, salivary gland tumors and microwave sickness syndrome.”

Martin Blank, PhD, Columbia University College of Physicians and Surgeons

“I am writing to urge a limit on WiFi, especially in flight WiFi. There is now sufficient scientific data on the biological effects of EMF, and in particular radiofrequency (RF) radiation, to argue for adoption of precautionary measures. EMF can cause single and double strand DNA breakage at exposure levels that are now considered safe. EMF have been shown to cause other potentially harmful biological effects, such as leakage of the blood brain barrier that can lead to damage of neurons in the brain, well below the current safety limits.”

The World Health Organization - International Agency for Research on Cancer May, 2011

“The Working Group did not quantitate the risk; however, one study of past cell phone use (up to the year 2004), showed a 40% increased risk for gliomas in the highest category of heavy users (reported average: 30 minutes per day over a 10-year period)... the evidence, while still accumulating, is strong enough to support a conclusion ... that there could be some risk, and therefore we need to keep a close watch for a link between cell phones and cancer risk.”

A National Institutes of Health cell phone study (February 23, 2011) in the American Medical Association journal (JAMA) shows that 50 minutes of cell phone radiation increases metabolic activity in the brain. This study was conducted by a well-regarded and influential team of researchers from the National Institutes of Health (NIH) and the Brookhaven National Lab (BNL.) "The study is important because it documents that the human brain is sensitive to the electromagnetic radiation that is emitted by cellphones," Nora Volkow, MD reported.

Whether these short-term changes will lead to health consequences (and what they might be) is far from clear – though Volkow already has preliminary indications of a long-term effect. Nor is the mechanism of interaction yet known. But the new finding at the very least forces a rethink of the prevailing orthodoxy, which maintains that low levels of RF and microwave radiation are too weak to have any effect and can be disregarded.

David Carpenter, MD the director of the Institute for Health and the Environment in Albany, NY states, "It's going to be very difficult to deny that RF radiation from a cell phone does not alter nervous system activity." Carpenter, a neurophysiologist, has been active in the electromagnetic research community for over 30 years, "This work will turn the whole issue around."

Oncology professor Lennart Hardell, MD, PhD of Sweden's Örebro University Hospital adds, "It's time to stop denying the existence of non-thermal effects."

“Chronic exposure to wireless radiofrequency radiation is a preventable environmental hazard that is sufficiently well documented to warrant immediate preventative public health action.”

COMMERCIAL PILOTS MAY BE EXPERIENCING WiFi-RELATED SYMPTOMS:

A Captain for a Canadian commercial air carrier writes, “Having read a lot of research on this topic, and hearing first-hand how other airline employees are reacting to wi-fi, in hotel rooms and elsewhere, I am certain that this form of radiation is having a negative health effect on many of us. The number of airline employees this year, including pilots and flight attendants, who report having difficulty with WiFi seems to be growing. Evidently, there are some pilots off sick with mysterious Parkinson-like symptoms. I can experience ill effects including nausea, shortness of breath, overall body weakness, and when in a sustained WiFi environment, I have difficulty focusing, and have skin reactions. I get these symptoms in hotels, the terminal, my flight planning area and also from cell phones brought onboard the aircraft. I do not experience these symptoms when away from this exposure. I will be unable to continue flying if wi-fi is installed on my aircraft. Safety of the aircraft and the health of those onboard, not entertainment, should be the priority!”

“I am a First Officer for a US air carrier. When I fly the WiFi-equipped A321 my joints hurt with inflammation and arthritic-like pain. It typically takes about 24 hours for the pain to subside. Other symptoms can include severe headaches, shortness of breath, sleep problems. I do not get the same symptoms flying the non-WiFi aircraft even though they are in the same family. Airport terminals are now another challenge. If I have to spend any excessive time in them I get the same reactions as I do from the WiFi equipped aircraft. Hotel overnights – all in WiFi rooms – are another problem for me now. When I sleep in a non-WiFi room, I sleep much better.”

A Partial Summary of Biological Effects

- A 2009 study by researchers in Israel confirmed human subjects exposed to wireless radiation from cell phones had impaired cognitive functions, including slower response times to a spatial working memory task. (Luria, Eliyahu, Hareuveny, Margaliot, Meiran).
- Disruption to normal functioning of neurological, cardiovascular and endocrine systems (Lai, Salford, Becker, Cherry, Hurtado, Johansson, Karasek, Schilowsky)
- Leakage of the brain’s protective blood-brain barrier (Salford, Persson)
- Impaired cognitive functions, including reaction time (Mosgoeller, Scheiner, Lai, Becker, Cherry, Luria, Eliyahu, Hareuveny, Margaliot, Meiran)
- Increased agitation, sleep disruptions and food, chemical and electro-sensitivities (Becker, Holt, Rea)

Summary Scientific and Medical Issues

- There is no conclusive evidence that exposure from mobile phone radiation and in flight WiFi is without risk from a health and/or aviation safety perspective.
- There *is* evidence that even low levels of radio-frequency radiation emitted by WiFi routers and mobile devices can be harmful to human health and adversely effect human cognition and performance - even at government allowed levels, as reported in the BioInitiative Report on Government Standards and the Seletun Statement.
- There is no evidence, which we know of, that the accumulated exposures in a WiFi-enabled aircraft, with or without crew and passengers online, have been measured or monitored.
- We propose these factors should be fully investigated before allowing this new technology onboard.

Technical Issues: *Full statements follow these excerpts.*

Electrical Engineer Alasdair Philips:

“There are no long-term studies on this accumulated exposure. I would oppose WiFi being provided inside aircraft cabins. WiFi tests inside an in flight aircraft have shown that those sitting closest to the Access Points will be highly exposed.”

EMR/RF Technical Expert Katharina Gustavs:

“Since aircrafts are metal enclosures, any wireless transmitter such as Wi-Fi-enabled laptops and Smart phones, as well as Wi-Fi access points operating on the inside, will cause an exponential increase in RF radiation exposure. Due to reflection and resonance effects and multiple users, (secondhand) exposure levels can increase 1000% in hot spots, which in some instances may even exceed official exposure limits (Hondou 2006).”

Electrical Engineer Lawrence Gust:

“The Wi-Fi base stations placed in the cabin are the least of the problem. The Airbus A319, for example, has a maximum seating capacity of 156 people. The big problem comes when 100 passengers all connect with the aircraft WiFi at the same time.”

EMR expert Don Maisch, PhD:

“Electromagnetic interference (EMI) with the plane's electronic equipment is a potential problem given the endless introduction of wireless devices. My understanding is that the EMI problem with aircraft systems has still not satisfactorily been addressed.”

EMR/RF Technical Expert Peter Sierck:

“I am concerned about increased RF exposure to the passengers, sitting in seats closest to the routers in airplanes, and cabin staff members. It seems prudent to conduct proper RF testing to determine the levels the crew and passengers are exposed to before changing the air regulations.”

CONTRIBUTIONS INCLUDED FROM:

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Professor Devra Davis, PhD (Nobel Co-laureate, Epidemiologist)
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Vini Khurana, MD (Neurosurgeon, and Associate Professor of Neurosurgery)
Don Maisch, PhD (Researcher and EMR Consultant)
Robert Metzinger (Electronics Engineering Technologist)
Wilhelm Mosgoeller, PhD (Professor and Researcher at the Medical University of Vienna)
Alasdair Philips (Electrical/Electronic Engineer, Director of Powerwatch)
Hans Scheiner, MD (German Environmental Physicians Initiative)
Peter Sierck (industrial hygienist with IBE and IBN certification)
Stephen Sinatra, MD (board- certified cardiologist)

CARDIAC EFFECTS AND MORE MEDICAL ISSUES

Here is an open letter from a cardiologist concerned about potential cardiac impairment:

Stephen T. Sinatra, M.D., F.A.C.C.
February 28, 2012

RE: WiFi in Commercial Aircraft

The heart is a delicate and complex electromagnetic organ that can be adversely affected by exogenous signals from wireless technology and its microwave radiation. For this reason it is unwise to adopt this popular, but untested technology, in transportation, especially exposing passengers, pilots and other flight crew to onboard WiFi radiation.

As far as we know, no one has tested the accumulated exposures within the aircraft when a good number of passengers, and flight crew, are using their mobile devices.

I would like to see tests on pilots for potential cardiac – and cognitive – effects.

Another issue is who will monitor the usage of in flight mobile devices? For example, a Sat phone could present additional problems. While pregnant women, infants and children are particularly vulnerable to this radiation exposure, we are all at risk. This global implementation of WiFi technology is creating a new environmental health hazard, and this electro-pollution is the greatest medical threat of our time.

I know this because I am a board certified cardiologist and have been a Fellow of the American College of Cardiology since 1977. At the Manchester Memorial Hospital in Connecticut, I served in several roles, including Chief of Cardiology, Director of Cardiac Rehabilitation, and Director of Medical Education.

1. There are a growing number of people who have become electro-sensitive and develop adverse symptoms when exposed to even low levels of electro-magnetic radiation.
2. Symptoms – usually unrecognized – may include headaches, dizziness, nausea, feeling faint, pulsing sensations or pressure in the head, chest pain or pressure, difficulty concentrating, weakness, fatigue, and a racing or irregular heart accompanied by feelings of anxiety. These symptoms may seem diverse but they indicate autonomic dystonia or dysfunction of the autonomic nervous system.
3. We know that the heart is sensitive to, and can be adversely affected by, the same frequency used for WiFi (2.4 GHz) at levels a fraction of federal guidelines (less than 1%).
4. In the future, it is quite possible that we may see the need to provide WiFi-free areas in public spaces like airports, schools, offices – and in public transportation.

We do not know the long-term effects of low-level microwave radiation. The safety of this technology on human health has not been properly tested and I would advise that you follow the precautionary principle that states the following:

"In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."
(Rio Conference 1992).

The principle implies that we have a social responsibility to protect the public from exposure to harm, when scientific investigations have found a plausible risk. That “plausible risk” exists for microwave radiation at very low levels.

These protections can be relaxed only if further scientific findings emerge that provide sound evidence that no harm will result. In some legal systems the application of the precautionary principle has been made a statutory requirement.

In conclusion it is unwise to install wireless technology (WiFi) in public transportation, especially aircraft.

Stephen T. Sinatra, M.D., F.A.C.C.

Hans-Christoph Scheiner, MD, February 27, 2012

Equipping aircraft with WiFi is a dangerous experiment. The health and safety of passengers - and especially flight crews - are at risk. Accumulated electro-magnetic radiation exposure may become the new human factor in transportation.

Since our group the German Environmental Physician Initiative sent a letter in 2008 to the aviation industry stating our concerns, there has been a proliferation of WiFi in commercial aircraft, as you know.

In our view, before allowing the addition of WiFi, and its radio-frequency radiation, to the existing in flight exposures from cosmic radiation and solar flares, regulatory agencies should conduct an investigation into the short and long-term effects on human performance and human health. As far as we know, these tests have not been conducted, making the installation of WiFi and widespread in flight use of mobile phones, and other wireless devices, a very dangerous experiment, as I have stated.

We acknowledge WiFi is everywhere and there will be significant health consequences from these accumulated exposures. However, there are specific concerns in transportation, especially aviation which must be evaluated. Radiation effects are magnified in aircraft – a metal 'Faraday' cage - and other confined metal spaces, as they are with increased altitude. The evidence that this presents health, and flight safety, hazards has increased. Is the government willing to take this risk? One of the issues is that no one knows how those who are affected will react. Reactions can include cognitive impairment and cardiac symptoms. Another concern is that no one is monitoring exposure for these or other adverse effects, including long-term cancer risks.

Even quite low levels of radio-frequency radiation - from WiFi and mobile devices - can open the blood-brain barrier and cause a lot of harm, including miniature edemas destroying brain cells cannot be renewed. This damage presents an increased risk of neurodegenerative conditions including Parkinson's disease.

May we ask that you also review the 2008 letter from our group of physicians.

Dr. med. Hans-Christoph Scheiner, Environmental physician, Münchner Ärzteappell

[This is the full letter written to many airline executives by Dr. Scheiner and the German Environmental Physician Initiative.]

Intended Authorization of Mobile Phones and Wireless LAN in Air Traffic

The information was spread in the media, that it is planned to allow the use of wireless communication devices like cell phones, W-LAN, and similar electronic tools on commercial flights. We are highly concerned about this fact.

As a technical innovation the susceptibility of electronic board systems in relation to microwaves has decreased (to be questioned here are the remaining risks): the personal use of wireless communication technology on commercial flights leads to serious health risks to all passengers and flight personnel.

Therefore it should be treated as a fact of the overall security of commercial airlines. Reason: If there are wireless systems permanently in use like cell-phone stations, W-LAN, Blue-Tooth, DECT, etc. in addition to active single cell phones and notebooks on flights with the duration of several hours, the passengers, crew and pilots would be exposed to excessive radiation of 25,000 nW/cm² and higher.

Even though these levels of exposure are just from 1/10 to 1/50 of the actual legal exposure limits, there are multiple scientific proofs of health risks. Even a radiation dose of 100-500 nW/cm² breaks the blood-brain barrier, which causes the entry of water, dissolving metabolism waste products, environmental toxins and blood proteins (especially albumins) into the central nervous system.

The fatal consequences are: miniature edemas occur in the complete brain, multiple selective swellings in non-renewable brain cells are irretrievably squeezed to death. They occur as dark neurons in the microscopic picture. Those dark neurons are proven to be possible starting points of very serious neurodegenerative diseases like Multiple Scleroses, Parkinson's disease, Alzheimer's disease, senile dementia and so on.

Many scientific studies with animal tests showed significantly this opening of the blood-brain barrier. Even low levels of 100-500 nW/cm² caused in more than 50% of the animals tested an opening of the blood-brain barrier. At the actual levels of 25,000 nW/cm², which are expected to occur on board commercial airplanes equipped with WiFi, 100% of the animals tested had serious brain damage.

The breakage of the blood-brain barrier under the influence of radio waves and high frequency, which happens at levels far underneath the current legal exposure limit, has obtained doubtless scientific evidence. This was significantly found and described by ALBERTS 1977, OSCAR AND HAWKINS 1977, NEILLY AND LIN 1986 SALFORD, BRUN, PERSSON, 1994, 1997, 2003 AUBINEAU AND TOERE 2001, 2003 SCHIRMACHER 1999, 2000 and many others.

Another fact: While the airplane is moving at an altitude between 8,000 and 12,000 metres, a reduced air pressure occurs inside of the plane, which equals the air pressure of 2000 – 3000 metres outside. Therefore the breakage of the blood-brain barrier is more likely because of the lack of oxygen and the well-known altitude sickness.

The severe consequences of the brain and nerve damage and safety of passengers are very concerning, especially those of the pilots, because they are already highly exposed from radar. The symptoms caused by high frequencies, like headaches, drowsiness, vertigo, nausea are often connected with loss of hearing and vision; lack of concentration and memorization are in this context known as the “Microwave-Syndrome” (JOHNSON-LIAKOURIS, 1998, MILD 1998, SANTINI 2001, 2002, 2003, NAVARRO, OBERFELD 2003).

Another dangerous result is the extreme slow down of the neuro-muscular response because of a doubled reaction time. Also the mental capacity is, in terms of cognitive disorders, verifiably heavily affected. Epidemiological studies and exposure trials with volunteers and animals show this clearly, see also the TNO-STUDY OF PROFESSOR ZWAMBORN 2003, KALODYSKI U. KALODYNKA 1996, PROFESSOR LAI U. SINGH 1966, 1997, 1998, ALTPETER U. ABELIN 1995, 1999, SEMM U. BEASOND 1996, ROSCHKE UND MANN 1996 and many more.

Because of the mostly fatal exits of flight accidents there are no special data about the influence from radio- and microwaves on flight safety and security available. But the knowledge we have from other traffic systems on the ground is surely transferable: in 2002, The British Transport Research Laboratory found that the time of a reaction of a car driver is 30% lower if he has been exposed to radio waves than the reaction time of an alcoholized driver, and 50% lower than the reaction time of a driver who has not been exposed to either.

In 1997 the University of Toronto (REDELMEIER AND TIBSCHIRANI) found out on the basis of a big trial that in relation to the length of exposure to radio waves of the car drivers, the drivers were 5 times as likely to cause an accident and twice as likely to cause a deadly crash. The same was confirmed by the RESEARCH GROUP OF VIOLANTI (1998) “CELLULAR PHONES AND FATAL TRAFFIC COLLISIONS”, similar facts were proved by PROFESSOR UNGER AT BREMEN UNIVERSITY: Cell Phone influence while driving leads even for experienced drivers to a 30% increase in changing and stopping mistakes!

In this context the following is very interesting: it has been proven multiple times that the use of cellular phones cause electroencephalography changes of the brain waves! Because of this it was possible for DR. VON KLITZING AT LUEBECK UNIVERSITY to prove that highly pulsed frequencies like mobile phones lead to pathologically EEG-patterns of the brain in the so called “alpha-rhythm”. This EEG area represents our physical and mental relaxing and recovering phases. The “alpha-rhythm” is shown while we sleep and dream. Pathological EEG changes in this alpha-area – show up most at 10 Hz – are an indication of a deep radio wave caused disorder of our physical and mental health, which reaches deep into our subconscious. Those EEG changes were already

proven before DR. KLITZING by Russian and American researchers, and after him often reproduced, for example by the German Department for Work Safety and Occupational Medicine in 1998 (FREUDE ET. AL.), by THE UNIVERSITY OF ZUERICH UNDER PROF. ACHERMAN, HUBER, BORBELEY ET AL. 1999,2000,2002,2003).

The above explanations include that radio waves also cause serious sleep disorders. It is also proven multiple times that radio waves cause a decrease in the sleep and body defense hormone Melatonin. (BURCH U.A. 1997, 1998, 1999, 2000, REITER U. ROBINSON 1994,1995, ABELIN U. ALTPETER 1995, 1999 U.A.M.) Let's not forget about the intermediate massive impairment of our microcirculation and therewith the oxygen supply of our inner organs and brain caused by the tendency of our red blood cells to stick together under the influence of radio waves. (DR. PETERSOHN 1998, RITTER UND WOLSKI 2005).

In addition to this PROF. KUNDI (Environmental hygienic department of Vienna University) found a high increase of heart attacks, strokes, thromboses and embolism in people who live near transmitter masts. All of these are disorders that could lead to an immediate airplane crash, with hundreds of victims, if this would happen to pilots. And finally the following is for all airlines to consider: electrosensitivity and electroallergies to wireless electronic devices already bother 10% of the worldwide population, and this tendency is rapidly increasing. Even short flights, but especially long ones, on which the passengers are constantly given a continual exposure of radio and microwaves would lead to a reduction of bookings and a recognizable decrease in sales for airlines which permit cell phone systems, notebooks and similar wireless instruments on board.

This has already been seen in Germany and other countries where electro-sensitive or allergic people avoid high-speed trains because of permanently active "Repeaters" (amplifiers of HF-signals). This is one of the facts that cause the above described microwave syndrome (headaches, nausea, drowsiness, vision disorders etc) and their change over to using different ways of transportation like cars, buses and trains without Repeaters.

The decrease of sales is doubtless continuing, and will do so even more as passengers realize what kind of danger permanent radio and microwaves on board hold for flight security. We ask you not to ignore these scientific facts about the dangers of radio and microwaves.

Dr. med. Hans-Christoph Scheiner, Environmental physician, Münchner Ärzteappell
Munich, July 24^t, 2008.

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February 18, 2012

Re: Health effects of in-flight WiFi

I have been active in research on biological effects of electromagnetic fields (EMF) for over thirty years at Columbia University. I was also one of the organizers of the 2007 online Bioinitiative Report that reviewed the latest research on EMF safety and made recommendations to remedy existing errors and base standards on biological effects. The report was cited by the European Parliament when they voted to review EMF safety standards. I am writing to urge a limit on WiFi, especially in-flight WiFi, where passengers have no way of avoiding exposure.

There is now sufficient scientific data on the biological effects of EMF, and in particular radiofrequency (RF) radiation, to argue for adoption of precautionary measures. EMF can cause single and double strand DNA breakage at exposure levels that are now considered safe...

EMF have been shown to cause other potentially harmful biological effects, such as leakage of the blood brain barrier that can lead to damage of neurons in the brain, well below the current safety limits. Probably the most convincing evidence of potential harm comes from living cells themselves when they start to manufacture protective stress proteins upon exposure to EMF. This means that when stress protein synthesis is stimulated by radiofrequency or power frequency EMF, the body is telling us in its own language that RF exposure is potentially harmful.

Many potentially harmful effects, such as the stress response and DNA strand breaks, occur at non-thermal levels (field strengths that do not cause a temperature increase) and are therefore considered safe.

It is obvious that the safety standards must be revised downward to take into account the non-thermal responses that occur at much lower intensities. Since we cannot rely on the existing standards, the precautionary principle appears to be the most reasonable approach for those who must protect the health and welfare of the public.

Sincerely yours,
Martin Blank, Ph.D.
Associate Professor of Physiology and Cellular Biophysics

INTERNATIONAL EMF EXPOSURE STANDARDS: Professor Blank is one of the scientists in the BioInitiative Report calling for revised exposure levels to be brought into line with the science – to be biologically based.

<http://www.bioinitiative.org/>

MORE EVIDENCE OF COGNITIVE IMPAIRMENT

We have seen other human performance issues including a study on RF radiation by Horst Eger, MD (Eger and Buchner, Rimbach, Germany 2011) indicating adverse effects on neurotransmitters with sleep and rest, vertigo, and concentration problems.

In 2009, we saw evidence of cognitive impairment from Wi-Fi and cell phone radiation by researchers Professors Kundi and Mosgoeller of the Vienna Medical University.

From Professor Wilhelm Mosgoeller, PhD:

“During the investigations of healthy human subjects, effects of GSM-900 and UMTS fields were studied under double-blind conditions whereby exposure levels were below current exposure guidelines at all times. During and after the actual exposure, certain brain waves (the so-called EEG alpha band, 8-13 Hz) changed. Some of the changes were statistically significant. And some CNS responses to acoustic and optical stimuli (so-called evoked potentials) mediated by brainwaves remained significantly changed even 30 minutes after the exposure. We noted faster response times during exposure, which, however, seem to occur at the expense of the quality of the response because wrong responses, in particular, were given within shorter time periods.”

There is a wealth of evidence about the health risks associated with this technology, so it is not a question of insufficient evidence anymore. This is now about the conflict between commercial interests of an industry supported by the government and the protection of public health.

The BUND warns: "The ubiquitous exposure to this unnatural type of radiation at unprecedented levels of power density harms human health. Short-term and long-term health impairments are preprogrammed and will especially manifest in the next generation if politically responsible actions are not taken immediately."

TECHNICAL ISSUES

Alasdair Philips, qualified in Electrical and Electronic Engineering

I am a practising electrical engineer and scientist, and have advised the British government and other groups on electro-magnetic radiation (EMR) issues. At first I thought wireless technology was brilliant. I now believe that the mistake we are making will have much more serious long-term adverse effects on our well-being than either smoking tobacco or asbestos. As you know, most airports and other public spaces are now wireless 'hot spots' of RF radiation. As you may not know, this is affecting us all.

And there are a growing number of people who are electro-sensitive (ES) and suffer mild to serious symptoms in a wireless environment. Most ES people already can't travel in planes, with the aircraft's electro-magnetic fields, with video screens built into the seats etc., let alone in-flight WiFi. I have measured fields in a Gulf Stream 550 taking off from and landing at national UK airports and circulating around the UK. I also measured the passenger cabin which was WiFi enabled. Highest readings by far were the airport radars (10s of volts per metre). Next was the WiFi, which was similar to the aircraft DME signals from the transponders mounted below the fuselage. We are told the radiation levels are "well within government health and safety limits."

Planes are not an EMF-friendly environment even now. Most have in-flight video screens built into the back of each seat. These are a source of high-frequency fields both for the people watching the screen and for those whose seat it is fitted into. There are also signals from various plane transponders mounted under the fuselage which make their way up into the cabin at surprisingly high levels. Many planes also have an emergency Iridium phone system that is internally active all the time they are in the air, with active handsets at both ends of the plane using a pulsing DECT (digital) cordless phone like signal 24-7.

We are also told that in-flight WiFi – as well as airport security scanners – are safe and emit lower levels than what we receive from cosmic radiation during the flight, or being on the earth's electro-magnetic fields. False assurances.

Security scanners present a significant problem for flight crews, with already high occupational exposure, and frequent flyers who must pass through these scanners frequently. The key point is the bombarding of the skin with a mass of electrons. That may, or may not be a significant problem, but there has been almost no work done to test it on animals (or humans) at these relatively low energy levels. And there's now the additional exposure of on-board wi-fi. There are no long-term studies on this accumulated exposure. I would oppose WiFi being provided inside aircraft cabins. WiFi tests inside an in-flight aircraft have shown that those sitting closest to the Access Points will be highly exposed. *Alasdair Philips, February 28, 2012*

Without any additional Wi-Fi radiation exposure, air travel already puts a high level of stress on flight personnel and passengers, including cosmic radiation exposure, reduced oxygen and air pressure, extended periods of immobility in a confined space, etc. Since aircrafts are metal enclosures, any wireless transmitter such as Wi-Fi-enabled laptops and Smart phones as well as Wi-Fi access points operating on the inside will cause an exponential increase in RF radiation exposure. Due to reflection and resonance effects and multiple users, (secondhand) exposure levels can increase 1000% in hot spots, which in some instances may even exceed official exposure limits ([Hondou 2006](#)).

But even at levels below Health Canada's Safety Code 6 ($10,000,000 \mu\text{W}/\text{m}^2$), passengers may develop headaches, dizziness, and tachycardia, which is why all precautionary EMF guidelines recommend to keep ambient RF radiation levels as low as possible, certainly below $1000 \mu\text{W}/\text{m}^2$ ([Salzburg Resolution 2000](#)) or $170 \mu\text{W}/\text{m}^2$ ([Seletun Consensus Statement 2011](#)). In building biology, we prefer to keep RF exposure levels below $10 \mu\text{W}/\text{m}^2$ ([SBM-2008](#)). These precautionary EMF guidelines are easily exceeded within close range of activated Wi-Fi-enabled laptops and smartphones as well as Wi-Fi access points.

Not only does low-level RF radiation interfere with the proper functioning of the human body, avionics systems are not immune, either. For example, an aircraft wireless terminal was found to interfere with a ground base station "even from a distance of 286 km" ([Moraitis 2010](#)). In a worst-case scenario, Honeywell display units on a Boeing 737NG went blank during EMI certification testing of Wi-Fi systems ([Boeing 2011](#)). The U.S. Aviation Safety Reporting System has many incidents on file where personal electronic devices used by passengers cause interference with the avionics systems ([ASRS 2011](#)). The current trend is to design aircrafts that are more immune to the ever-increasing level of RF radiation from personal electronic devices ([Walen 2008](#)), but where does that leave human health.

Unnecessary and potentially harmful RF radiation exposure as well as electromagnetic interference with avionics systems can be avoided by hardwiring each seat for Internet access. At minimum, any in-cabin wireless network for passengers should be based on optical radiation, which would eliminate any interference issue with avionics systems. Moreover, with optical radiation it would be much easier to establish exposure-free zones within the aircraft for those who require them for medical reasons and those who prefer them for health reasons—just a simple curtain would block this form of radiation. For the protection of public health, of course, hardwired is the way to go.

Rob Metzinger, Electronics Engineering Technologist, BBEC, President Safe Living Technologies Inc.

Having Wi-Fi on a commercial airliner poses 2 concerns for me. One concern being the intensity of the exposure levels to the passengers, crew and the pilots the other concern being the risk of Electromagnetic interference on the navigation equipment.

As an EMF mitigation specialist, I have seen instances where electronics signals can impact other electronics in their surroundings. This concerns me with the in-flight navigation equipment. With Wi-Fi devices in an aircraft, the following signals would potentially be present: W-LAN, Bluetooth, DECT, cell phones, Notebooks to name a few. Each of these devices radiates a unique wireless signal pattern which can couple onto the backbone wiring of the aircraft if it is not properly shielded. If the signals are intense enough, electromagnetic interference "EMI" could result thus impeding the functionality of an in-flight control system.

Exposure levels of the crew and passengers are also an issue as the fuselage of an aircraft is metal. Metal is a known reflector of radio waves and microwaves. This means that radio-frequency energy generated by the Wi-Fi transmitters will be reflected around the cabin elevating RF exposure. As each person activates his or her personal Wi-Fi device the exposure to all passengers and crew will increase as well. One of the side effects of exposures to this type of radiation is delayed reaction time. The last thing a pilot needs is having his reaction time impeded.

Don Maisch, PhD Environmental Building Survey Consultant

I am a member of the Australasian College of Nutritional and Environmental Medicine (ACNEM) and have published numerous papers on various aspects of EMR exposure, from health related issues to reducing EMR in the workplace.

My concerns mirror those of Rob Metzinger. Electromagnetic interference (EMI) with the plane's electronic equipment is a potential problem given the endless introduction of wireless devices. The paper at the end of this document is from 1997 but my understanding is that the EMI problem with aircraft systems has still not satisfactorily been addressed. If we apply a risk/benefit approach, why provide the benefit of passengers being able to use these devices for entertainment for a few hours flight when the risk, even if very remote, is a catastrophic electronic failure at a critical time in the plane's journey. SAFETY SHOULD BE PARAMOUNT!!!

Another issue is that the microwave emissions will be reflected back into the cabin from the curved metal skin. This **IS** an occupational Health and safety concern for flight crews who will be spending much of their work time bathed in these emissions.

Lawrence Gust, Electrical Engineer, and Faculty & Board of the International Institute for Building Biology & Ecology

RE: the installation of WiFi on airplanes

The WIFI base stations placed in the cabin are the least of the problem. The Airbus A319, for example, has a maximum seating capacity of 156 people. The big problem comes when 100 passengers all connect with the aircraft WiFi at the same time.

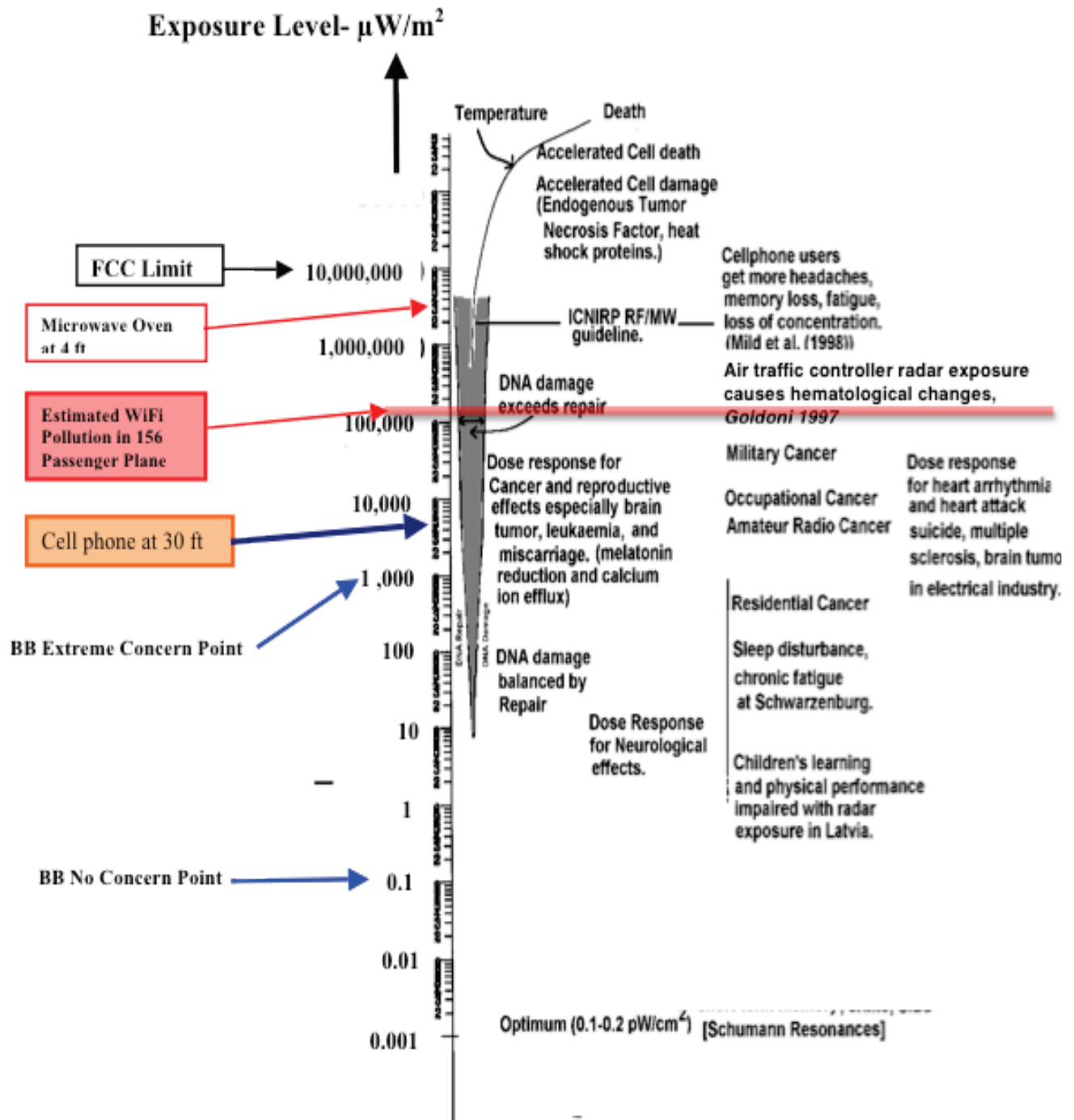
Measurements made in Germany a few years ago quantifying the RF power density of a single PC at 5 feet as $1580 \mu\text{W}/\text{m}^2$. Multiply this by 100 and you get $158,000 \mu\text{W}/\text{m}^2$. All this radiation is bouncing off the metal skin of the plane running in to other radiation streams and reinforcing at the intersections. In my view this is an absolutely stunning power density that all passengers must sit through for the duration of the flight. This is worse than second hand smoke on planes before smoking was banned. And on those planes the ventilation system provided 100% outside air, but now there is no escape from the RF pollution. If passengers knew what the attached RF Effects graph shows, non-using passengers would be very unwilling guinea pigs for this diabolical experiment. The installation of WiFi on airplanes is insane.

With 3% of the population reacting to smart meters the minute they are installed and another 15% becoming sensitized in four or so weeks we will have a great number of very uncomfortable passengers and some no doubt will be permanently impaired. The radiation from all digital wireless devices having the same qualities can be expected to invoke a reaction in many people and I think it's going to murder some passengers through stroke or heart attack.

[Mr. Gust includes the following charts]

*Larry Gust,
March 3, 2012*

Reported Biological Effects of RF Radiation



Source: www.wave-guide.org/library/studies.html

12/20/06

Digital Radiation Density from Wi-Fi (Wireless Internet)

Munich Airport, Hall D

Distance from Wi-Fi Antenna Feet	Wi-Fi (IEEE 802.11b) Radiation $\mu\text{W}/\text{m}^2$
6 to 16	23,000
33	320
66	80
164	20

University of Bremen 2001

Radiation Source	Distance from Source Feet	Wi-Fi (IEEE 802.11b) Radiation $\mu\text{W}/\text{m}^2$
Base Antenna	16	50 to 100
Base Antenna	6 to 12	520 to 660
Base Antenna	Highest Level	2500
Computer Antenna	5	1580
Computer Antenna	2	3150
Computer Antenna	0.6	158,000

Research conclusions and opinions about the effects of exposure to such radiation vary. Some are of the opinion that exposure to pulsed digital communications radiation is much more detrimental than exposure to non-pulsed radiations from radio, TV and microwave transmissions. We feel it is best to be conservative as there are enough red flags waving about pulsed digital radiation for the building biologist to be concerned.

Baubiology Sleeping Room Guidelines for Pulsed Radiation

Ideal < 0.1 $\mu\text{W}/\text{m}^2$ for pulsed radiation

Weak 0.01 to 5

Strong 5 to 100

Extreme > 100

Extracted the report of Dr. Thomas Haumann, WLAN, DECT Study, April 2003 (in German)

11/30/03, Wi-Fi Radiation Tables, Haumann.doc lecture

Neurological Conditions and Electro-hypersensitivity

There are many symptoms connected with EMR exposure including difficulty sleeping, headaches, dizziness, eye pain, cardiovascular reactions, and many more. Medical researchers also suggest an extensive range of brain and nervous system-related conditions.

Dr. Hans Scheiner has treated thousands of people with electro-hypersensitivity (EHS) symptoms:

Some people are electro-allergic – not only sensitive but hyper-sensitive. When they are exposed they have headaches, sleeping problems, exhaustion during the day, dizziness, vomiting, tachycardia, concentration and memory problems. They may faint or their vision might be impaired. It's likely these are signs of opening of the blood-brain barrier. Doctors often tell them their symptoms are psychological.

Dr. Scheiner says an electro-hypersensitive person can usually recover from the symptoms by avoiding the exposure. The next step along the continuum is what he calls an electro-allergic reaction, in which the body's response is a real illness. Some will feel no ill effects – then suddenly will be hit with something as serious as cancer, high blood pressure or a stroke.

Dr. Scheiner also says people who have had cancer are more susceptible to developing electro-hypersensitivity; their bodies are likely too busy fighting the cancer to be able to fend off this extra assault.

Dr. Scheiner's observation:

Each symptom, like the headaches, sleep disruption, dizziness etc. can be unspecific – caused by a lot of different reasons. It gets specific, however, when you experience several of these – this could be what we're calling microwave syndrome – this is not a sickness, it is a warning system.

Your body is trying to alert you, saying, 'I'm having trouble here, get me out of this situation'. These symptoms are a call for help. As you may know, in our conventional medical system, it is often our approach to deal with these symptoms, in a sense trying to shut the body up, masking the calls for help and giving relief of the symptoms.

The cause of the distress, however, may not be addressed and therefore continues the harm. What we see, clinically, is that this can progress to more serious conditions.

Insomnia, Stress, Mood

As Dr. Scheiner describes, your ability to sleep can be a good indicator of your EMR exposure and sensitivity.

Many people who are not sleeping well may be unknowingly immersed in a high EMR environment. We know the agitating effect of EMR on the brain. Is it any wonder that difficulty sleeping is one of the primary and most prevalent symptoms?

EMR exposure has been shown to make it more difficult to “wind down” and can also reduce the amount of melatonin in the brain. According to some research, using a cell phone for more than 25 minutes a day for two weeks can be enough to reduce melatonin levels. Katharina Gustavs adds, “According to J. Burch’s research, the effect is exacerbated if you sit in a dimly lit office for most of the day.”

As you may know, this hormone is necessary for deep, restful sleep, which also allows the body to recharge and heal itself.

Dr. Scheiner has treated thousands of people with EHS symptoms and agrees the number of people affected is on the rise:

Some people are electro-allergic – not only sensitive but hyper-sensitive. When they are exposed they have headaches, sleeping problems, exhaustion during the day, dizziness, nausea, vomiting, tachycardia, concentration and memory problems. They may faint or their vision might be impaired. It’s likely these are signs of opening of the blood-brain barrier. Doctors often tell them their symptoms are psychological.

Dr. Scheiner says an electro-hypersensitive person can usually recover from the symptoms by avoiding the exposure. The next step along the continuum is what he calls an electro-allergic reaction, in which the body’s response is a real illness. Some will feel no ill effects – then suddenly will be hit with something as serious as cancer, high blood pressure or a stroke.

FROM ALASDAIR PHILIPS, UK ELECTRICAL ENGINEER:

In the slide below from Professor Anderson of Aalborg University, who specializes in antennas and mobile communication, the WiFi access point (transmitter/receiver) is marked in the top front corner of the cabin and then they calculated and measured the RF power density exposure of the passengers.

The lower right-hand-side graph shows the exposure levels and, as would be expected, they get much higher in the seats closest to the WiFi access point.

These are the only measurements I have heard of w.r.t. WiFi in aircraft.

At these levels of exposure, headaches, fatigue, muddled thinking, confusion, irritability, generally increased stress, and in principle also cardiac symptoms - yes, all seem possible, and likely, in some passengers and flight crew.

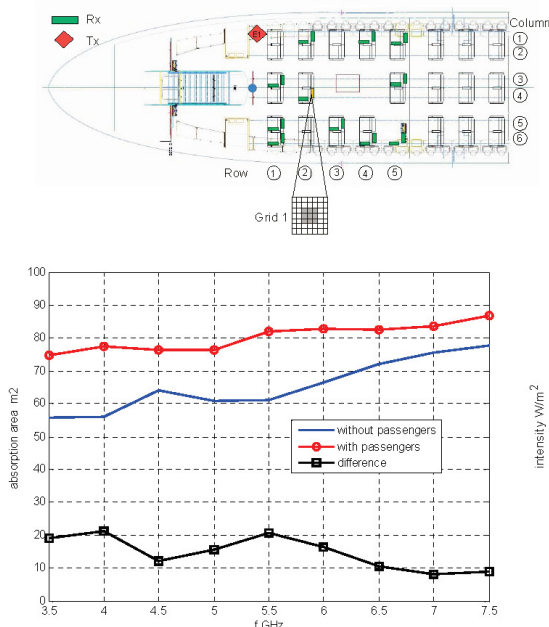
FROM US EXPERT LARRY GUST:

Assuming that is the Full Wave power density and using what I assume to be statistically smoothed experimental data (LOS theory line) these are the results at three distances from the source. **These levels could induce cardiac arrest.**

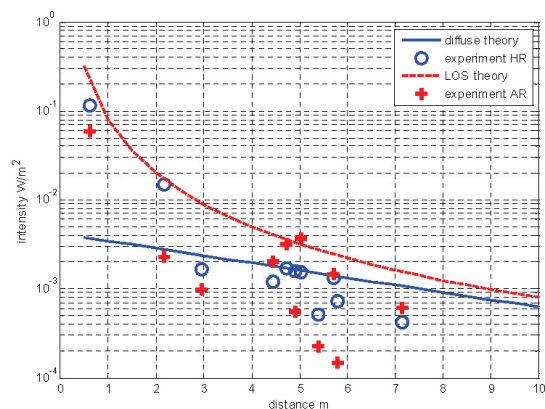
FROM EUROPEAN EXPERT KATHARINA GUSTAVS

Any RF exposure above $100 \mu\text{W}/\text{m}^2$ is considered a significant concern.

At 10 m the background level is still between 600 and 800 $\mu\text{W}/\text{m}^2$.



Measuring whole-body-absorption by real people



Incident power density determines whole-body SAR . The closest takes all!

http://ec.europa.eu/health/electromagnetic_fields/docs/ev_20111116_co12_en.pdf

2013 Up-date

Boeing receives approval from the FAA for “Earth Stations Aboard Aircraft.”

<http://apps.fcc.gov/ecfs/comment/view?id=6017160713>

Our technical team responds to the remarks of an aerospace engineer connected with committee: (Evidently, he also said they had not considered the effects with a planeload of people online.)

Committee engineer: The plane is not a faraday cage when airborne.

Katharina Gustavs: Whether this metal container of an aircraft is airborne or not, it functions more or less as a Faraday cage due to its large metal components.

Neuroscientist Professor Olle Johansson, PhD of the Karolinska Institute: a metal/aluminum airliner is an excellent Faraday's cage.

Rob Metzinger: The plane is not a complete faraday cage but almost. Multiple reflections of RF will occur inside of the fuselage. As more users use their wireless device the levels would increase but would still probably remain below existing standards of exposure.

and flight attendants and pilots have worse effects from gamma radiation.

Professor Johansson: So then we can booster them with some harmful microwaves as well?

KG: Yes, gamma radiation is worse. However, considering that two thirds of the radiation effects of gamma radiation are mediated through an excess of free radicals; it won't help matters when another agent such as Wi-Fi radiation is added that is also known to cause free radical stress.

RM: Cosmic radiation has always been a serious concern when flying. Now we are adding a new type of radiation to the mix. Not a good idea especially for the crew.

There would be a lot of radiation from all of the devices but that the antenna on top of the planes is directional to the satellite and then a wire feeds into the plane.

KG: Yes, the majority of the radiation exposure would come from the devices used inside the aircraft. But this wire from the outside antenna will be hooked up to an antenna or a number of access points inside the aircraft, which would cause the highest exposure to those closest to them.

The metal protects one from the radiation and it is within the standards and safe.

KG: Yes, the metal will reduce the exposure to outside RF sources, which is most likely within the "standards," but I would not call this safe. There are so many Wi-Fi-enabled devices (e.g. tablets, smartphones, etc.) that do not come with the option of a wired connection that, even if Ethernet ports are provided onboard, people would not be able to use them, except for they still have an old-fashioned notebook. The engineers do not seem to have a problem with fitting an entire computer into a slim smartphone. I think there should also be room for a miniaturized Ethernet port. Most people do not realize that their smartphones, for example, contain many wireless transmitters, including Wi-Fi, which they hardly ever use all at once. They not only cause the battery to drain quickly but also to increase their exposure. Imagine the possible effect of all these interfering signals, whether airborne or not.

Partial List of References Concerning This Issue:

Summarizing the Science – by researcher Henry Lai, PhD

Reporting biological effects of radiofrequency radiation (RFR) at low intensities

- Kolodynski and Kolodynska (1996)- school children who lived in front of a radio station had less developed memory and attention, their reaction time was slower, and their neuromuscular apparatus endurance was decreased.
- Mann et al. (1998)- a transient increase in blood cortisol was observed in human subjects exposed to cellular phone RFR at 0.02 mW/cm². Cortisol is a hormone involved in stress reaction.
- Persson et al. (1997)- reported an increase in the permeability of the blood-brain barrier in mice exposed to RFR at 0.0004 - 0.008 W/kg. The blood-brain barrier envelops the brain and protects it from toxic substances.
- Santini et al. (2002)- increase in complaint frequencies for tiredness, headache, sleep disturbance, discomfort, irritability, depression, loss of memory, dizziness, libido decrease, in people who lived within 300 m of mobile phone base stations.
- Tattersall et al. (2001)- low-intensity RFR (0.0016 - 0.0044 W/kg) can modulate the function of a part of the brain called the hippocampus, in the absence of gross thermal effects. The changes in excitability may be consistent with reported behavioral effects of RFR, since the hippocampus is involved in learning and memory.

Studies cited by neuroscientist Sarah Starkey, PhD

Lai, H., 2007, Evidence for effects on neurology and behaviour, Bio-Initiative Report, www.bioinitiative.org (accessed August '08).

Landgrebe M., Hauser S., Langguth B., Frick U., Hajak G. and Eichhammer P., 2007, Altered cortical excitability in subjectively electrosensitive patients: results of a pilot study, *J. Psychosom Res.*, 62(3), 283-288.

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Nittby H., Grafstram G., Tian D. P., Malmgren L., Brun A., Persson B. R., Salford L. G., Eberhardt J., 2008, Cognitive impairment in rats after long-term exposure to GSM-900 mobile phone radiation, *Bioelectromagnetics* 29(3), 219-232.

Vecchio F., Babiloni C., Ferreri F., Curcio G., Fini R., Del Percio C. and Rossini P. M., 2007, Mobile phone emission modulates interhemispheric functional coupling of EEG alpha rhythms, *European Journal of Neuroscience* 25, 1908-1913.

Wiat J., Hadjem A., Wong M. F., Bloch I., 2008, Analysis of RF exposure in the head tissues of children and adults, *Phys Med Biol* 53(13), 3681-3695.

WHO (World Health Organisation), 2006, Electromagnetic Hypersensitivity, Proceedings of the International Workshop on EMF Hypersensitivity, Prague, 2004, https://www.who.int/peh-emf/publications/reports/EHS_Proceedings_June2006.pdf

See the BioInitiative Report www.bioinitiative.org and the Seletun Statement [International EMF Alliance](http://www.international-emf-alliance.org)

This research demonstrates mobile phone radiation can affect the brain:

EFFECT OF ELECTROMAGNETIC RADIATION FROM MOBILE PHONE ON THE LEVELS OF CORTICAL AMINO ACID NEUROTRANSMITTERS IN ADULT AND YOUNG RATS

Y.A. KHADRAWY*, NAWAL A. AHMED**, HEBA S. ABOUL EZZ**, N.M. RADWAN**

*Medical Physiology Department, National Research Center, Giza, Egypt **Zoology Department, Faculty of Science, Cairo University, Giza, Egypt

Abstract:

The present study aims to investigate the effect of electromagnetic radiation (EMR) generated by mobile phones on the levels of amino acid neurotransmitters; glutamate, aspartate, GABA, glycine and taurine in the cortex of adult and young rats. Several studies showed that EMR could influence normal brain physiology, probably by changing cortical excitability. In the present study, adult and young rats were exposed to EMR for one hour/day. Amino acids were measured after 1 hour, 1, 2 and 4 months of daily EMR exposure and after 1 month of stopping exposure that extended daily for 4 months. The present data showed that in adult rats EMR induced significant changes in the cortical levels of some studied amino acids throughout the exposure periods. However, in young rats EMR induced significant changes after 4 months of daily exposure and after stopping exposure. It could be suggested that the changes in amino acid neurotransmitters may underlie the EMR-induced changes in cortical excitability.

More Commercial Pilots Express Their Observations & Concerns

The following letter was sent to us by Dr. Maisch. While much has changed since this was written, it contains some noteworthy points and raises some good questions.

Electromagnetic Interference with Aircraft Systems: why worry?

Peter B. Ladkin with colleagues, October 1997

Jim Irving is a colleague who flies B737 aircraft for a major US carrier. He reported:

One day departing Portland Oregon we noted that the FMC [Flight Management Computer] Map display showed a disagreement with the "raw data" VOR position. Our training is such that we would normally immediately switch over to "raw data" and assume the FMC was in error. We would have done that except that it was a beautifully clear day and I looked out the window and was able to determine that the FMC seemed to be right on. I called back to the cabin and asked the flight attendants to check for someone using a cell phone or computer. A few minutes later they called back to say that a man had been using his cell phone and it was now off. Strangely (?) our VOR and FMC map now agreed.

Later in the flight the flight attendants called back and said that they had caught the man using his cell phone again but this time we had not noticed any problems, perhaps because we were in cruise far from the ground and not paying as much attention.

Andre Berger is a colleague who flies B737 aircraft for a major European airline and who has had first-hand experience of some of these incidents. While interference is not proven, he believes it gives considerable cause for concern; and that while it may be difficult to demonstrate the relationship using Brunnstein's 'forensic' criterion, this could be due to the fact that the equipment needed to do so is not on board the aircraft at the times the incidents occur. Berger monitors the IATA confidential incident reports, and also has some experience of his own to contribute: In our company we recently had a Localizer deviation (out of tolerances) on a B737-200 related to a GSM (mobile phone) being operated by a passenger (who was disregarding our company regulations).

When requested by the cabin crew to switch off his GSM, localizer indications became normal. Is this scientific proof? Certainly not, but good enough for me as a captain to insist that all the electronic toys, computers, mobile phones, etc., are OFF during critical phases of flight. I had fuel indications on the FMC going crazy on board the B737, that returned to normal when all electronic stuff in the back was switched off. I suspect a "Gameboy" electronic game device to have interfered, but this is no more than a guess. No, I did not ask to switch the toy back on again and investigate more in depth as I was responsible for the safety of 140 passengers and this would

have been extremely irresponsible! This is not a situation in which to do such testing! This [ever-present responsibility accounts for why] there is no "proof" of the relationship.

I also recall experiencing *impossible* mode annunciations on the FMA (flight mode annunciator) on B737. Having both the autothrottle AND the pitch channel of the autopilot trying to maintain speed (both in MCP SPD mode) for example, not programmed by the pilot (you *cannot* program that). After an expensive in-depth troubleshooting session by our maintenance department, the incompatible mode annunciations were traced to a ... faulty cockpit window heat wiring. This caused electronic interference with the auto flight system.

Berger has also recounted two more incidents: June 07, 1997. B737-300: *Verify position* was indicated on the CDU. Both IRS and radio position were correct, the FMC position was not. The difference rapidly increased to 8 nautical miles. After switching a GSM in the cabin from STBY to OFF, the FMC updated normally. FMC was correct for the remainder of the flight and on the return flight.

April 30, 1997. B737-400: During level cruise, the AP pitched up and down with ROC/ROD of 400 fpm indicated. Other AP was selected: no change. Cabin was checked for PC's and other electronic devices: nothing was found. Requested passengers to verify that their mobile phone (GSM) was switched OFF. Soon after this request all pitch oscillations stopped.

Just glitches or did interference really occur? Don't know, but EMI (electro-magnetic interference) is a problem that needs more research.

Apparently, there are also some incidents with older aircraft. There was one incident reported with a B737-200. During approach to MAN (Manchester International, UK), the LOC for landing runway 24 oscillated and centered with the aircraft not on track (but offset), confirmed visually. Ground equipment was monitored and working normally. When a GSM in the cabin was switched off, all indications became correct.

Frank McCormick, an aerospace engineering colleague who is also a FAA Designated Engineering Representative, wonders about the physics of such possible incidents: The threat levels presented by the gadgetry in question -- personal computers, cellular phones, compact-disk players, hand-held video games and so on -- are mere background noise compared to the threat levels that must be demonstrated during environmental qualification testing [of the aircraft systems]. How could an FMC [Flight Management Computer] pass, say, DO-160C [standard certification] tests, yet lose its mind in the presence of a cell phone on standby?

Peter Mellor, of the Center for Software Reliability at City University in London, reports that The cabling on the A320 has not only been tested for resilience to "normal" EMI, but for its ability to withstand the much greater pulse that would result from the aircraft flying through a

powerful radar beam, for example. While doubting that the suspected-EMI phenomenon is ubiquitous, McCormick suggests that some sort of systematic investigation could proceed by inviting protagonists (actual airplane, pilots, customer with suspect device) to participate in attempts to reproduce the incidents. Berger reports that in fact very few systematic tests are performed anyway: he asked a major portable phone manufacturer's representative what tests they performed for EMI from their devices in aircraft.

The manufacturer performed none because use of cellphones is illegal in aircraft at this time. Berger notes that nevertheless such tests are relevant, because these phones are frequently used surreptitiously or inadvertently on aircraft. He also notes that most electromagnetic interference testing is 'bench-testing', performed on independent subsystems, and that this may suggest an interesting suspect point of weakness in the aircraft, namely the system interconnections. Recall one of the incidents he noted above: neither the electronics nor the well-shielded wiring itself, but the wiring *connections* seem to have been problematic.

He reports incidents to specific aircraft (whose registration 'tail numbers' are also given in the reports): On a specific B737-300, a MCP (mode control panel) was doing weird stuff intermittently during several flights. I mean really weird: like letting both pitch and autothrottle fight each other to maintain speed. Nearly all boxes involved (MCP, FCC, several AFDS boxes) were changed before a clever mechanic found out that the windshield heat was not correctly grounded. This is located just a few inches from the MCP and is one of the big consumers on board. Tightening a few nuts solved an engineers nightmare.

On a specific B737-400, the FMC was doing weird things, mainly in cruise. Some pilots reported that after a request to the passengers to switch off electronic equipment, the problem was solved, others said it did not help anything even with every electronic gadget switched off in the cabin. Others reported nothing abnormal with CD's, PC's, Gameboys and more of that stuff trying to jam the system unsuccessfully. Troubleshooting was done and it was decided to replace another black box that was suspected. It was pulled out but, no spare was available. So the same black box was pushed in again. Problem solved, it never happened again!

Connections are a possible weak point. And difficult to duplicate if a problem exists. Can an imperfect connection make a tested system EMI susceptible or not? He emphasises, as do the RTCA and the other correspondents, that more research and systematic methods of testing are urgently to figure this situation out.

John Dimtroff is an electrical engineer on the Transport Standards Staff of the FAA Transport Aircraft Certification Directorate in Seattle. He is also a member of the Joint Airworthiness Authority/Federal Aviation Administration Electromagnetic Effects Harmonization Working Group. He has been a Federal Communications Commission investigator and inspector, a Boeing RF design engineer and a US Air Force Radar Specialist. He reports some incidents first-hand:

... even the aircraft's own certified airborne equipment can play games on itself. A few years ago I was involved in identifying the source of navigation instrument indicator needle swings and voice modulations in the pilot's headset. The culprit turned out to be a certified airborne-authorized telephone broadcasting on a frequency which just happened to be commensurate with a piece of [navigation] equipment.

Another case involved the Flight Guidance Computer/Air Data Computer which was radiating unwanted signals, the 15th, 20th & 22nd harmonics of 6 & 8 MHz clock frequencies, which are right on the 120MHz & 132MHz VHF band! But each piece of this equipment met all the required RTCA DO-160 level testing requirements....my experience with the FCC has taught me to wonder how many [PED] devices transmit with a clean, zero-spur signal, especially after being dropped, banged, klunked, fondled and sat upon. In my former FCC investigative days, I saw a number of devices (computers, stereos, TV's, etc., etc.) which purportedly met FCC Part 15 requirements as indicated by their label, but were either bogus marked, illegally imported or were just outside the manufacturing quality bell curve. [My personal view is] that every carry-on electronic device is suspect -- until it has been individually tested, which, of course, is impossible. My experience suggests to me that it is nearly impossible to predict/replicate an EMI event on an aircraft when the event involves a portable carry-on device (PED). Location, orientation, power output, modulation, in conjunction with ALL the other PED's/electronics/electrics/avionics active at that time all play a role in the EMI event. And we must not exclude the terrestrial based emitters (radars, etc)

Ladkins' Conclusions

There are plentiful anecdotes of possible electromagnetic interference with aircraft systems. While the systems are subjected to thorough bench-tests under conditions of electromagnetic interference to demonstrate adherence to certification standards, there appears to be no systematic process for investigating and attempting to reproduce in-flight incidents, although the British Airways BASIS system, ASRS and EUCARE provide systematic logging of such reports, as one presumes do individual airlines for internal use. Possible explanations of the lack of reproducibility of such incidents center on the environmental differences between the 'bench tests' for certification, in which individual subsystems are tested independently, and the integrated aircraft environment. While entire aircraft are also subjected to some testing during certification, there may be individual differences between aircraft: if wiring connections are susceptible to interference, for example, then aircraft with a longer maintenance record may be more prone to interference incidents than brand-new ones. While there is considerable disagreement amongst experts as to whether the phenomenon -- or phenomena -- are indeed cases of electromagnetic interference from passenger electronic devices, the call for more systematic testing appears to be unanimous. I have argued that some change in the regulatory environment will help. Nevertheless it appears clear that, whatever one's view on the reality of the phenomenon, an increasing number of reports on correlation will continue to appear at ASRS, BASIS and EUCARE.